The London Close Reasoner LOGIC NOTE 3

The Eight Faces of Professor Venn

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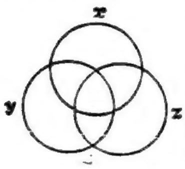
John Venn (1834-1923), to whom we are indebted for our circles, taught logic at Cambridge University in England. His book, *Symbolic Logic*, which was based on his lectures, was first published in 1881[1].

The circle idea is this: given a Universe of Discourse and some terms, we draw a diagram of overlapping circles (or other shapes), one for each term, in such a way that there is a space for *every* possible subdivision of the Universe based on those terms. Three terms means eight subdivisions (2^3), including the space outside the circles.

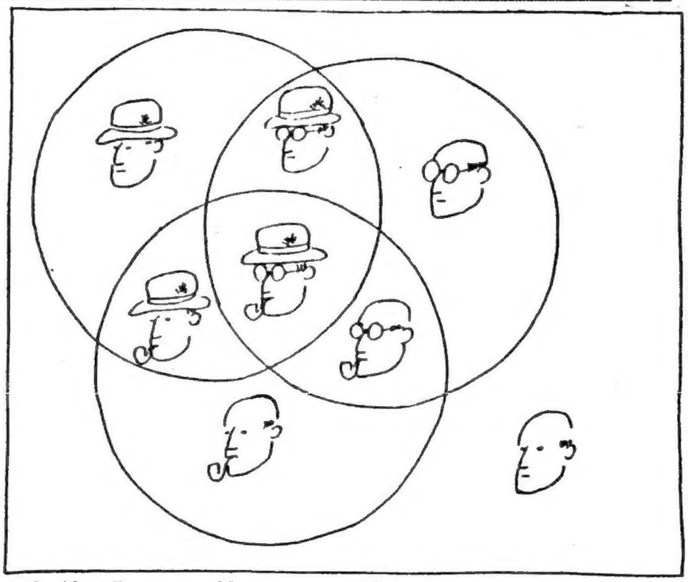


This diagram itself is just a blank form waiting to be filled in. To enter information we use the following two conventions:

NONEXISTENCE: To record the fact that a certain area is empty, that no objects exist there, we shade out the area.

EXISTENCE: To record the fact that a certain area has an object existing in it we run a 'star-track' through the area. This means putting a star in each of the subdivisions of the area, and then joining the stars together with a line. This means that at least one of the stars corresponds to an existing object[2]. (of course, if there is only one subdivision the n just use a single star and forget the track.)

To use these diagrams to assess arguments we first recall the logician's definition of *validity*: **an argument is valid if and only if the combination of true premises with false conclusion is impossible.** We apply this definition by seeing whether or not we can write that combination into a diagram; the argument is valid if we can't, invalid if we can.

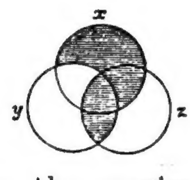


Professor Venn in his own Universe of Discourse, refracted through three terms[3].

The routine is first to diagram in the premises and then to see whether we can add the *contradictory* of the conclusion. If we can, it shows that the true-premise-false-conclusion combination is possible; if we can't, it is not possible.

For example, consider Venn's diagram for **Celarent:** (EAE-I)

No Y is Z
All X is Y
so, No X is Z



The Major Premise empties the region common to **Y** and **Z** (call it the **YZ** region). the Minor empties the part of **X** that is outside of **Y** (call it the **X**$\underline{\textbf{Y}}$ region, $\underline{\textbf{Y}}$ being the complement of **Y**). The contradictory of the conclusion (diagonal on the square of opposition) is **Some X is Z;** to add this to the diagram we would need to put a star-track in the **XZ** region, but we are blocked since ~~we~~ the premises

1. References here are to the second, revised, edition of 1894, reprinted in 1971 (New York: Burt Franklin).

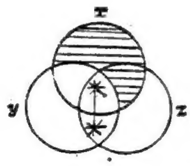
2. Venn actually used a different method for showing that an area is occupied, as we will see in an example below. Present day logic books use many different conventions for this aspect of Venn diagrams.

Those with military imaginations may wish to compare star-tracks to the proposed American MX missile system; the missiles are to be kept on railway cars running on special tracks, and shifted frequently from silo to silo so that the Russians, though knowing that there is a missile on the track somewhere, will not know which silo it is in.

3. Drawing by Patrick Maynard.

have declared that region to be empty. So the syllogism is valid.

Now consider:



Some Y are Z
All X are Y
so Some X are Z.

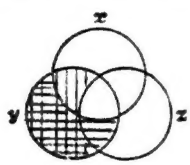
The Major puts the star-track in **YZ**; the Minor empties **X$\underline{\mathbf{Y}}$**. The contradictory of the conclusion is **No X are Z,** which wants to empty the **XZ** region. No problem; it means that *one* of the stars goes but that is all right since another star on the track would survive. The argument is invalid.

It should be clear from these examples how to diagram our standard propositions:

A: **All S are P:** Empty the part of **S** that is outside of **P** (**S$\underline{\mathbf{P}}$**)
E: **No S are P:** Empty the part that is common to **S** and **P** (**SP**).
I: **Some S are P:** Lay a star-track in the area common to **S** and **P** (**SP**).
O: **Some S are not P:** Lay a star-track in the part of **S** outside of **P** (**S$\underline{\mathbf{P}}$**).

The above is what we have on the *modern* interpretation, which is the one Venn preferred. If we want the *traditional* interpretation we have to add further star-tracks to guarantee that for every circle there is both something in it and something outside it.

This example shows the difference: **Darapti:** (AAI-III)



All Y are Z
All Y are X
so, Some X are Z

The contradictory of the conclusion is **No X are Z,** which would mean emptying **XZ.** On the modern interpretation that is no problem, and the syllogism is invalid. On the traditional interpretation, however, we can't do it; it would empty the whole **Y** circle, and that is not allowed.

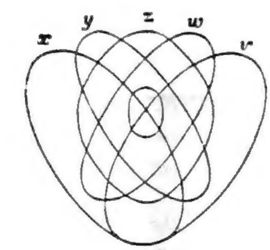
Venn was actually less interested in syllogisms than in more complicated examples involving four or more terms.

For four terms he used a pattern of ellipses, as in this example:

> At a certain examination centre, where either Greek or Latin is a compulsory subject, it is a rule that any one who takes Greek or Latin only must take ~~take~~ both English and French; and that any one who takes both Greek and Latin must take either English or French. It is supposed to be known that every combination of three of these languages is, as a matter of fact, taken by some candidate; can we thence infer that there are really any candidates who take all four?

> Draw the diagram ... as usual; the assigned regulations abolish, respectively; G$\underline{L}$, $\underline{G}$L$\underline{E}$, $\underline{G}$L$\underline{F}$, G$\underline{L}$$\underline{E}$, G$\underline{L}$$\underline{F}$, GL$\underline{EF}$[4]. Shade these out, including of course what lies outside.
>
> Now the assigned empirical facts establish the existence, respectively, of GLE, GEF, GLF and LEF: mark these by 1, 2, 3, and 4[5]. It is obvious that all these four compartments can be just saved without the necessity of resorting to the central portion. That is, though there *may* be candidates who take up all four subjects, we cannot infer that there *must* be any. (p. 132)

For five terms Venn uses a diagram, like this, the ellipse for **Z** being a sort of doughnut with the little ellipse in the middle of the diagram as its hole.



Venn was serious; though this might look like nothing but a great tangle of figures, he says:

> "It must be admitted that such a diagram is not quite so simple to draw as one might wish it to be...I can only say for myself that having worked hundreds of examples, I generally resort to diagrams of this description, in order to save time, to avoid unpleasant drudgery, and to make sure against mistake and oversight." (p. 117)

In the present day, however, Venn diagrams are seldom used for anything more complicated than three term problems. There are other methods for the more complicated cases, but that needn't concern us here.

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4. Venn uses overbars instead of underlines for the complements, a typographical feat beyond the reach of the *LCR*.

5. Venn's alternative to our star-track system of representing existence.